Estimating Regional Deformation from a Combination of Space and Terrestrial Geodetic Data

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Deformation analysis, though dominated today by GPS data, can take advantage of terrestrial measurements, particularly high precision electronic distance measurement (EDM) concentrated on active faults, and global satellite laser ranging (SLR) and very long baseline interferometry (VLBI) observations spanning over a decade. An appropriate combination methodology is necessary to provide a rigorous solution with efficiency and flexibility.

In this study, wc first obtain loosely constrained estimates of geodetic parameters from individual experiments. These estimates are then combined into a single solution, estimating site. velocities, coseismic displacements, and allowing stochastic variation of site coordinates and orbital and Earth rotation parameters when appropriate. Finally, wc impose general constraints to define a uniform reference frame. Our methodology will be presented in terms of Kalman filter equations, with formulas given for goodness-of-fit and compatibility tests in the case of genera] ized constraints.

The velocity field for southern California estimated by *Feigl et al.* **[*JGR* 98, 21677, 1993]** from GPS and VLB1 measurements was strong in the western Transverse Ranges area but weak in the southern Borderlands area. GPS data recently analyzed by *Bennett et al.* [*EOS*, this issue] for the Salton Trough and Riverside County (STRC) and by *Hudnut et al.* [*BSSA*, Northridge special issue, in press] from the Caltrans and Intercounty surveys fill the gaps south of the Ventura basin. Interseismic velocities determined from these data, however, arc weakened by the lack of fiducial stations in the early experiments and by co-seismic displacements from the Joshua Tree and Landers earthquakes. EDM data collected since 1974 by the USGS in the Joshua plain and Salton Trough *[Savage and Lisowski, JGR, 100,* 12703, 1995] strengthen the determination of velocities and coseismic displacements but must rely on the GPS and VLBI measurements to maintain orientation over a wide area. We combine all of these data to estimate both interseismic velocities and coseismic displacements.

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